

# Risk of Respiratory Illness Associated with Day-care Attendance: A Nationwide Study

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**ABSTRACT.** The risk of respiratory and other illnesses in children (age groups: 6 weeks through 17 months, 18 through 35 months, and 36 through 59 months) in various types of day-care facilities was studied. Children considered exposed to day care were those who were enrolled in day care with at least one unrelated child for at least 10 hours per week in each of the 4 weeks before the interview; unexposed children were not enrolled in any regular child care with unrelated children and did not have siblings younger than 5 years of age receiving regular care with unrelated children. Although an increased risk of respiratory illness was associated with attending day care for children in all three age groups, this risk was statistically significant only for children 6 weeks through 17 months of age (odds ratio = 1.6; 95% confidence interval = 1.1 to 2.4) and children 18 through 35 months of age who had no older siblings (odds ratio = 3.4; 95% confidence interval = 2.0 to 6.0). In contrast, day-care attendance was not associated with an increased risk of respiratory illness in children 18 through 35 months of age with older siblings (odds ratio = 1.0). For children aged 6 weeks through 17 months, the exposure to older siblings was associated with an increased risk of respiratory illness; however, for children aged 36 through 59 months, older siblings were protective against respiratory illness. In addition, for the children in each age group currently in day care, increased duration of past exposure to day care was associated with a decreased risk of respiratory illness. It is estimated that during the period of the study approximately 10% of respiratory illnesses in the United States in children younger than 5 years of age were attributable to day-care attendance. *Pediatrics* 1991; 87:62-69; day-care facilities, respiratory illness.

**ABBREVIATIONS.** ARE, attributable risk in the exposed; PAR, population attributable risk; CI, confidence interval.

In recent years, interest has been growing in the possible health-related risks that result from the increasing use of day-care facilities in the United States. Among the illnesses of concern are infections of the upper respiratory tract, the most common cause of illness in children attending day-care facilities, as well as diarrheal illnesses, hepatitis, and *Haemophilus influenzae* infections. Infections of the upper respiratory tract, although typically mild, are of increasing interest because of their possible association with otitis media and associated complications.<sup>1,2</sup> We conducted a study to assess the risk of respiratory and other illness related to attending various types of day-care facilities. This study provided the opportunity to assess the risk of respiratory illness in children of various ages attending day-care facilities and to assess previously suggested characteristics of day-care exposure and their potential role in the risk of day-care-associated respiratory illnesses.

## METHODS

The study was designed to compare the rates of respiratory and other illnesses in exposed vs unexposed cohorts of children in each of three age groups: 6 weeks through 17 months (group 1), 18 through 35 months (group 2), and 36 through 59 months (group 3). Exposed children were defined as having child care with at least one unrelated child for at least 10 hours per week in each of the 4 weeks before interview. A child was considered unexposed if neither the child nor any siblings

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younger than 5 years of age had any regular child care with unrelated children during this interval. The study was designed to enroll at least 262 exposed and 262 unexposed children from each age group.

Children in the study cohorts were selected through a nationwide telephone survey that incorporated a random digit-dialing, cluster-sampling technique. A preliminary screener determined the age and exposure status of any children younger than 5 years of age in the household. The parents of all exposed children and a random sample of unexposed children (who were relatively more prevalent than exposed children) were subsequently administered an in-depth questionnaire which sought information including the occurrence of any respiratory or diarrheal illnesses and associated symptoms in children in the previous 2 weeks; exposure (both in and outside the home) to other children, immunization histories, and current and past child-care arrangements.

All interviews were conducted between March 12 and June 17, 1987. More than 35 000 households were called; 28 500 (81%) agreed to participate by completing the screening and when selected, the in-depth questionnaire. Of the participating households, 10% (2853) had children younger than 5 years of age. Of the 3475 children identified in these households, 29% could be classified as exposed, 60% as unexposed, and 11% did not meet the study definition of exposed or unexposed.

### Analyses

Primary analyses in this study focused on comparing the risk of respiratory illness among exposed and unexposed cohorts within 2 weeks before the interview; analyses were conducted separately for each age group. Although multiple children from the same household were enrolled in this study, one child at most (the youngest) from a given household was included in the analysis of each age group. This ensured that all the observations within each age group were independent; hence, standard statistical techniques could be used in each separate analysis. Comparisons of risk between age groups were conducted restricting the analysis to children without siblings.

To control for the effect of possible confounders and to identify potential interaction effects, we used multiple logistic regression analysis. Logistic models were developed as follows. For each age group, factors previously reported or suspected of being risk factors for childhood illnesses were screened by using Mantel-Haenszel statistics (see Table 1). The factors identified as potential con-

TABLE 1. Variables Considered for Multivariate Models

Region of country
Race (white, nonwhite)*
Income (<\$20 000)*
Mother's education (<high school)
Crowding (1 or more persons per room)
Work in day care or babysitting
Smoking at home by family members*
Siblings in household*
Current breast-feeding (age group 1 only)*
Month of interview*

\* Core variables selected for inclusion in model. (The variables without asterisks were not included in the model because eliminating them changed the exposure odds ratio by less than 5%.)

founders or interaction variables in any age group were selected as core variables, which were used in the logistic models for each of the three age groups. The variable "current breast-feeding" was used only in the youngest age group.

Logistic regression analyses were completed separately for each age group. The baseline logistic model included exposure, age, and the core variables as main effects. Two-way interaction terms involving exposure were then added to the baseline model stepwise (*P* value to enter, .05). Finally, the variables not involved in significant interactions were dropped from the model if their absence changed the exposure odds ratio by less than 5%.

We also examined the following three characteristics of day-care exposure to assess their association with respiratory illness: number of other children in the day-care setting, number of hours per week currently in day care, and length of time previously in day care. To simplify the analysis of these factors, we eliminated from the exposed group the children who were currently attending more than one day-care facility or who had switched day-care facilities. Multivariate logistic models incorporating these additional variables were developed from the final exposure models already described.

To take into account the complex survey design, we used RtiLogit, a program that incorporates the design effect into the variance estimates of the logistic parameters, to run the final logistic models.

### Illness in Families

The rates of respiratory illness in the families of exposed children and the families of unexposed children were also examined. Families were classified as exposed if a child (in any age group) attended day care; they were classified as unexposed if their children did not attend day care. Again, multivariate models were developed, as described earlier.

TABLE 2. Demographic Characteristics of Children Exposed (Exp) and Children Unexposed (Unexp) to Day Care by Age Group

Characteristic	Age Group					
	6 wk-17 mo		18-35 mo		36-59 mo	
	Exp (n = 192)	Unexp (n = 351)	Exp (n = 302)	Unexp (n = 383)	Exp (n = 463)	Unexp (n = 446)
Mean age, mo	11.0	9.0	27.0	26.8	48.4	47.1
Race/ethnicity, %						
White	77.2	74.6	82.2	76.5	72.3	73.3
Black	7.8	8.3	9.6	9.1	14.6	9.0
Hispanic	6.2	11.7	2.6	7.6	6.0	9.9
Other/unknown	8.8	5.4	5.6	6.8	7.1	7.8
Maternal education, %						
<High school	6.4	14.6	7.1	13.7	6.7	10.9
High school	42.3	43.9	40.2	43.3	39.2	52.4
Some college	24.3	24.5	26.0	22.5	26.2	21.4
College degree	27.0	17.0	26.7	20.5	28.0	15.3
Income (in thousands), %						
<\$20	24.4	34.8	23.1	32.1	23.2	35.7
\$20-35	32.6	33.6	33.3	36.6	30.1	34.8
>\$35	38.9	25.6	38.6	26.1	40.6	22.4
Unknown	4.2	6.0	5.0	5.2	6.0	7.2
Region, %						
Northeast	16.6	25.9	19.8	26.9	19.6	19.5
South	37.8	23.1	34.0	25.9	36.8	24.9
North Central	25.9	28.5	26.1	25.3	26.2	30.5
West	19.7	22.5	20.1	21.9	17.4	25.1
Siblings <18, %						
None	39.6	27.9	40.7	23.0	25.9	13.5
Older	60.4	72.1	52.0	64.5	55.3	64.3
Younger only	0	0	7.3	12.5	18.8	22.2

### Attributable Risk

The attributable risk in the exposed (ARE) estimates the percentage of cases of illness in exposed children that is attributable to the exposure (day care); the population attributable risk (PAR) measures the percentage of the total cases of illness in exposed children and unexposed children that is attributable to the exposure.

For each age group the ARE and the PAR were calculated by using the following formulas:

$$ARE = (I_E - I_U)/I_E$$

$$PAR = P_E (I_E - I_U)/I$$

where  $I$  is the 2-week age-specific incidence of respiratory illness in the total population and  $P_E$  is the proportion of the total population exposed to day care. Because this study excluded children exposed 1 to 10 hours per week, we assumed in estimating  $I$  that the incidence in this group was similar to the incidence in the unexposed group.  $I_E$  represents the estimated incidence of respiratory illness in the exposed population;  $I_U$  is the estimated incidence in a demographically similar unexposed population (ie, adjusted for income, race, and presence of siblings). Logistic regression models were used to calculate these incidence rates.

### Selected Infectious Diseases in Past Year

Included in the questionnaire were questions about the occurrence in the past year of overnight hospitalizations and 15 specific infectious diseases. Because the exposures and the ages of subjects were different, these analyses were done on a person-year basis. Rates were standardized for region, income, and presence of siblings. Statistical significance was assessed by using the method of Breslow and Day to compare standardized mortality ratios.

### RESULTS

#### Demographic Characteristics

Comparing the demographic characteristics of the exposed and the unexposed cohorts in each age group revealed that the unexposed tended to have lower levels of maternal education and household income and were more likely to be of Hispanic ancestry (Table 2). Unexposed children were also more likely to have siblings than were exposed children and less likely to live in the South. These and other differences between exposed and unexposed cohorts were considered and, where appropriate, adjusted for in subsequent multiple logistic analyses.

### Characteristics of Day-care Exposure

Table 3 displays various characteristics of day-care exposure. As required by the definition of day-care exposure, all children were enrolled for at least 10 hours per week. Approximately 50% of children in each age group were in day care for 40 or more hours per week (mean time in each age group: 35, 34, and 33 hours per week, respectively). Prior time in day care increased as age increased; almost half (47%) of the children in group 3 had been enrolled in day care for at least 18 months. The percentage of exposed children in small child-care arrangements (6 or fewer children) decreased with age, ranging from 70% of children in group 1 to only 31% of children in group 3.

### Antecedent Illnesses and Events

During the 2 weeks before the interview, the children in all three age groups exposed to day care were more likely to have had a respiratory illness than those not exposed to day care. Furthermore, in each group of children with a respiratory illness, a higher percentage of exposed than unexposed children reported two or more respiratory symptoms (ie, cough, fever, runny nose, sore throat, earache), received antibiotics, and consulted or visited a health care provider (Table 4).

Multiple logistic regression analyses demonstrated that the overall odds ratio for respiratory illness associated with day-care exposure was 1.6 (95% confidence interval [CI], 1.1 to 2.4) for children in group 1 and 1.3 (95% CI, 0.95 to 1.8) for children in group 3 (Table 5). Among those in group 2, the presence of siblings significantly reduced the odds ratio for day-care exposure. Further analysis in this age group of the effect of siblings demonstrated that the day-care odds ratio for children

with younger siblings only was similar to that for children with no siblings and that the aggregate odds ratio for these children was significantly elevated (3.4, 95% CI, 2.0 to 6.0). In contrast, the odds ratio for children with older siblings was significantly lower than above and not significantly different from 1. In the other age groups the odds ratio was not significantly affected by the presence of siblings.

Multiple logistic analysis concerning children without siblings (thereby allowing direct comparisons of age groups) demonstrated day-care odds ratios of 1.8, 3.7, and 1.5 for age groups 1, 2, and 3, respectively. The odds ratio for children in group 2 was 2.0-fold higher (95% CI, 0.74 to 5.4) than that for children in group 1 and 2.4-fold higher (95% CI, 0.93 to 6.4) than that for children in group 3.

To further assess the possible independent risk of respiratory illness due to exposure to older siblings, we also calculated odds ratios of respiratory illness associated with other siblings (Table 5). In group 1, the odds ratio (1.7) was significantly elevated. In group 3, the odds ratio was significantly below 1, suggesting that in this age group the risk of respiratory illness was lower in children with older siblings than in those without. In both these groups, no interaction with day-care exposure was observed. For children in group 2, the older-sibling odds ratio was affected by day-care status. For those not in day care, the odds ratio for older siblings was significantly elevated; however, among those in day care the odds ratio was less than 1.

### Characteristics of Day-care Exposure Related to the Risk of Illness

Using exposure to a single day-care facility, we included 87%, 80%, and 72% of exposed children in age groups 1, 2, and 3, respectively, in the analysis. For each age group, the odds ratio of respiratory illness associated with current day-care exposure did not differ significantly between part-time (<40 hours/week) and full-time care.

For each age group the Figure displays how the duration of past day-care exposure influences the odds ratio of respiratory illness associated with current day-care exposure. Within each age group, the protective effect of longer enrollment in day care was statistically significant. In group 1 the odds ratio of respiratory illness for those exposed less than 9 months was 2.3 times as great as the odds ratio for those exposed greater than 9 months. Similarly, for those in age groups 2 and 3, exposure to day care for less than 9 months was associated with a 2.1- and 2.2-fold-greater odds ratio, respectively, than was exposure for 18 to 27 months. As

TABLE 3. Characteristics of Day-care Exposure\*

Characteristic	Age Group		
	6 wk-17 mo	18-35 mo	36-59 mo
Size of day-care facility			
2-6	133 (70)	167 (56)	141 (31)
7+	58 (30)	133 (44)	317 (69)
Prior time in day care			
<9 mo	116 (67)	94 (32)	154 (34)
9-18 mo	57 (33)	84 (29)	86 (19)
18-27 mo		88 (30)	88 (19)
>27 mo		27 (9)	128 (28)
Hours/wk in day care			
≥10-19	29 (15)	38 (13)	109 (24)
20-39	60 (32)	115 (38)	141 (31)
≥40	101 (53)	148 (49)	207 (45)

\* Results are given as number (%) of children.

**TABLE 4.** Illness and Events Within 2 Weeks Before Interview: Children Exposed (Exp) and Children Unexposed (Unexp) to Day Care, by Age Group\*

Illness/Event	Age Group					
	6 wk-17 mo		18-35 mo		36-59 mo	
	Exp	Unexp	Exp	Unexp	Exp	Unexp
<b>All Children</b>						
Respiratory illness	34.2	26.5	37.6	29.5	25.8	21.5
<b>Children With Respiratory Illness</b>						
≥2 symptoms	78.8	73.1	80.7	70.8	82.5	71.9
Symptoms for ≥2 days	98.3	100.0	95.2	92.6	96.4	92.9
Consulted/visited health care provider	66.1	60.4	49.5	43.4	55.3	39.1
Received antibiotics	40.7	31.1	29.9	25.0	35.0	19.8

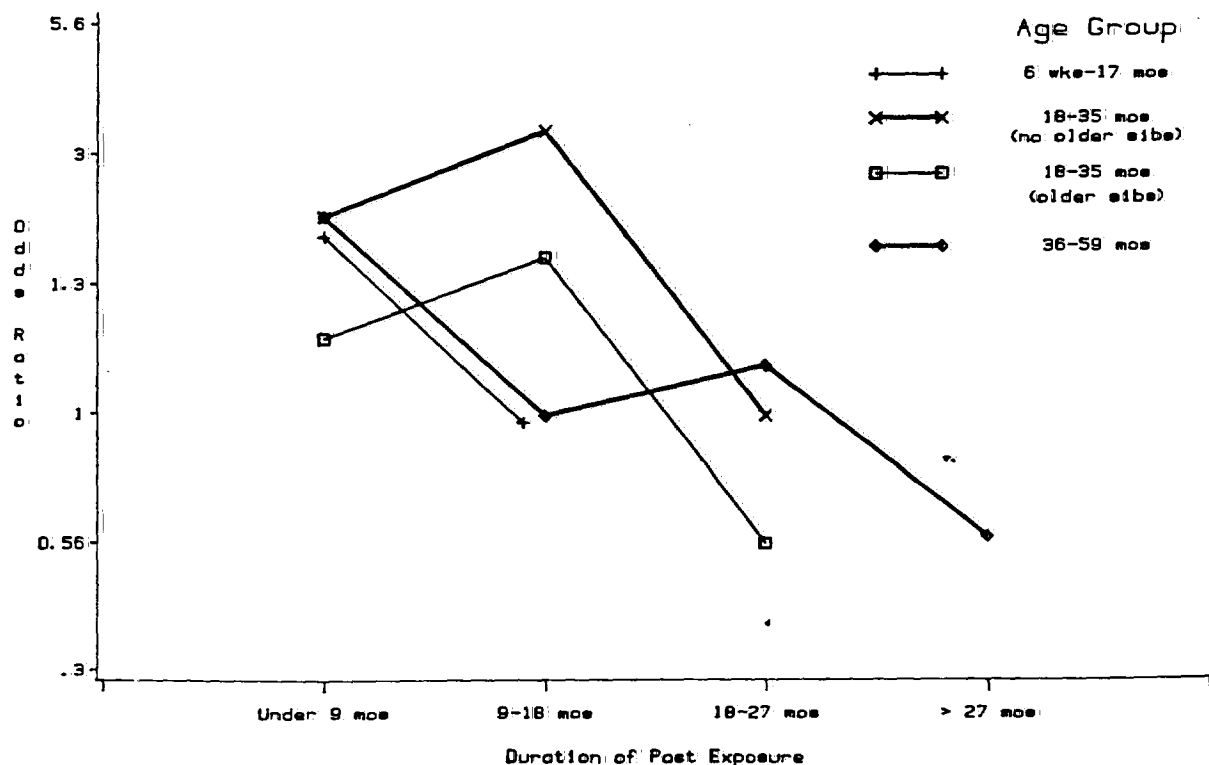
\* Results are percentages.

**TABLE 5.** Odds Ratios, by Age Group, for Respiratory Illness Associated With Day-care Exposure and With Having an Older Sibling\*

OR	Age Group		
	6 wk-17 mo	18-35 mo	36-59 mo
<b>Daycare OR (95% CI)</b>			
Older sibs		1.0 (0.65-1.6)	
No older sibs		3.4 (2.0-6.0)	
Aggregate†	1.6 (1.1-2.4)		1.3 (0.95-1.8)
<b>Older sibling OR (95% CI)</b>			
Day care		0.62 (0.38-1.0)	
No day care		2.1 (1.2-3.7)	
Aggregate†	1.7 (1.1-2.6)		0.60 (0.41-0.88)

\* OR, odds ratio; CI, confidence interval.

† Aggregate odds ratio used when no significant interaction observed.



**Figure.** Odds ratios of respiratory illness associated with day-care exposure by duration of past exposure and age group.

seen in the Figure, odds ratios well below 1 were observed in several situations. The odds ratio for children in group 3 who had been in day care for more than 27 months was 0.58 (95% CI, 0.23 to 1.1); the odds ratio for children in group 2 who had been in day care for more than 18 months and who had older siblings was 0.56 (95% CI, 0.22 to 1.03).

In each age group the odds ratio associated with larger (more than six children) vs smaller day-care facilities was elevated. This effect was greatest, and statistically significant, in group 2 (odds ratio = 2.2; 95% CI, 1.2 to 3.7). The odds ratios for large vs small centers were 1.6 and 1.4, respectively, for groups 1 and 3.

### Illness in Family Members

Respiratory illness in family members 5 years of age or older was highly correlated with the occurrence of respiratory illness in family members younger than 5 years of age in exposed and in unexposed families. Thirty-one percent (72/230) of exposed families with ill children younger than 5 years of age also reported a respiratory illness in a family 5 years of age or older compared with 12% (73/608) of exposed families with no ill children younger than 5 years of age; the comparable percentages for unexposed families were 36% (71/199) and 12% (90/744). Thirty-eight exposed families (4.5%), compared with 34 (3.6%) unexposed families, reported a respiratory illness in a family member 5 years of age or older that was preceded in the 2 weeks before interview by the onset of a respiratory illness in a family member younger than 5 years of age.

The results of the logistic model demonstrated that families that reported a respiratory illness in a member 5 years of age or older were 1.18 times as likely to have children in day care as were the families that reported no illness in a member 5 years of age or older (95% CI, 0.93 to 1.50).

### Attributable Risk

The ARE for respiratory illness was higher for groups 1 and 2 (28% and 33%) than for group 3 (18%). The PARs for the three age groups were 7.1%, 11.7%, and 7.7%, respectively. The similarity of the PARs in groups 1 and 3, despite the difference in AREs, reflects that a higher proportion of children in group 3 than in group 1 were exposed to day care.

### Infectious Illnesses in the Past Year

We compared the incidence rates of certain infectious illnesses in the year preceding the interview

by age and exposure status (Table 6). In each age group, the exposed incidence rate for chickenpox exceeded the unexposed rate; this difference was statistically significant for groups 1 and 3. No significant differences were observed in the incidence rates of selected other diseases listed in the table nor for respiratory-tract-related hospitalizations.

Because chicken pox was the only disease with enough cases for subset analyses, we used it to examine the effect of older siblings and the size of the day-care facility, two factors that are important for day-care-associated respiratory illness. Similar trends were observed. In groups 1 and 3 relative risks of more than 2 for day-care exposure were observed for the children with and children without older siblings. In group 2, however, only those without older siblings had an elevated relative risk (2.3); those with older siblings had a relative risk of 1.0. In addition, in each group, the risk for large centers exceeded that for small centers; relative risks of 1.6, 1.5, and 1.4 were observed for groups 1 through 3, respectively.

### DISCUSSION

The results of this nationwide study are consistent with observations from a number of studies conducted in smaller populations using a variety of methods, which suggest that day-care attendance is associated with an increased risk of respiratory illnesses in preschool-aged children.<sup>3-7</sup> In addition,

**TABLE 6.** Incidence Rates per 100 Child Years of Reported Infectious Illnesses in Past Year, by Age Group and Day-care Exposure\*

Disease	Age Group					
	6 wk-17 mo		18-35 mo		36-59 mo	
	Exp	Unexp	Exp	Unexp	Exp	Unexp
Chickenpox	9.5 <sup>  </sup>	3.5	11.2	8.2	19.5	8.3
Diarrhea lasting >1 wk	5.8	4.4	4.0	5.4	0.8	1.7
Vaccine-preventable diseases†	0.5	0.8	1.1	0.7	0.7	0.3
Other diseases‡	3.1	1.5	3.4	1.7	4.9	4.2
Respiratory-related hospitalizations§	3.0	3.1	2.1	2.0	0.3	0.0

\* Exp, children exposed to day care; Unexp, children unexposed to day care.

† Includes measles, mumps, rubella, diphtheria, and pertussis (no cases of mumps or diphtheria reported).

‡ Includes mononucleosis, scarlet fever, scabies, lice, hepatitis, meningitis, giardiasis, and *Haemophilus influenzae* (no cases of hepatitis or meningitis reported).

§ Includes pneumonia, influenza, bronchitis, asthma, and respiratory condition (unspecified).

|| Significant difference between exposed and unexposed rate.

this study allowed examination of a number of issues, including the effect of prolonged exposure to day care and to older siblings, which had not been assessed in earlier studies. This study illustrates the complexity of this day-care-associated risk and the fact that a number of factors, including age of the child, presence of older siblings in the home, duration of prior day care, exposure, and size of the day-care facility may affect the risk of such illnesses.

The risk of respiratory illness associated with day-care attendance increased for children in all three age groups, although it was statistically significant only for (all) children in the youngest age group and children without older siblings in the 18-through 35-month age group. The highest risk was observed in this latter group (odds ratio = 3.4). The risk of respiratory illness in children aged 18 through 35 months with older siblings was not affected by day-care attendance; however, these children did have an excess risk of respiratory illness when compared with children who had neither older siblings nor day-care exposure. This group may have no day-care-related risk of respiratory illness because older siblings and day care pose similar and competing risks in this age group.

Although authors have speculated about differing day-care-related risks among children of different ages, earlier studies have not examined the risk of respiratory illness among children of different ages, and many have not included children older than 36 months of age.

Infants and toddlers in day care have also been shown to have increased risks of other illnesses, particularly diarrhea.<sup>6</sup> Inasmuch as many of the modes of transmission of agents commonly responsible for diarrheal and respiratory illnesses are believed to be similar—including child-to-child contact and fomites or shared objects, which are frequently mouthed by infants and toddlers—the increased risk of both types of illness is not unexpected. The higher day-care-associated rate of respiratory illness in children aged 18 through 35 months compared with younger and older children may be related to an increased frequency of such practices in this age group. Additionally, the lower day-care-associated risk (and absolute rates) of respiratory illness in children aged 36 through 59 months may be related to the acquisition of relative immunity to common respiratory agents. Although this study was not designed to assess all possible differences among children of different ages, it does illustrate the importance of considering age when examining day-care-related risk of respiratory illness.

Although there has been considerable speculation about the impact of early and long-term enrollment

in day care on the risk of various illnesses, especially respiratory illnesses, this is the first study to assess this factor using large cohorts of children who have been in day care for different lengths of time. Our results suggest that among children attending a single facility (87%, 80%, and 72% in age groups 1, 2, and 3, respectively), longer exposure was associated with a decreased risk of respiratory illness. This seemed to be true regardless of the size of the facility and was apparent in each age group. Among children aged 36 through 59 months, those who had been in day care for 27 or more months had a lower risk than those unexposed to day care (odds ratio = 0.5), suggesting that prolonged exposure to day care may lead to a reduced risk of respiratory illness among older preschool children. It is possible that this reduced risk of respiratory illness extends into the school-aged years and results in decreased absenteeism during this period. On the other hand, the increased rate of respiratory infections during the earlier years may be related to an increased risk of otitis media and associated complications, an issue our study did not address.<sup>9-11</sup>

This study suggests that the presence of older siblings in the home, as well as day-care attendance, has an important, and perhaps similar, impact on the risk of respiratory illness in children younger than 5 years of age. Among children aged 6 weeks through 17 months, the odds ratios associated with older siblings and with day care were similarly elevated. Among those 18 through 35 months of age, the odds ratio associated with older siblings among those not in day care was elevated but of smaller magnitude than the odds ratio for day care among those without older siblings. However, among children 36 through 59 months of age, the odds ratio associated with older siblings was less than 1 (odds ratio = 0.54,  $P < .05$ ), suggesting a protective effect. Thus, prolonged exposure to older siblings seemed to reduce the risk of respiratory illness.

Although risk of respiratory illness increased in association with day care, the size of the day-care facility significantly affected this risk only among those children 18 through 35 months of age; attendance at a larger facility (more than six children) was associated with a significantly increased risk of respiratory illness when compared with smaller facilities (two to six children, odds ratio = 2.2). Although there is considerable evidence that larger day-care facilities are associated with an increased risk of certain illnesses, including diarrhea and disease caused by *H influenzae*,<sup>6,12</sup> studies concerning the importance of the size of the facility have been less conclusive and have not attempted to evaluate this risk among children of different ages.

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Wald et al recently reported that children younger than 18 months of age in smaller day-care facilities (two to six children) had an intermediate risk of respiratory illness between home care and larger day-care facilities; in our study, however, the difference between small and larger settings was not statistically significant for children younger than 18 months of age.<sup>4</sup> Strangert, too, found no evidence that increasing the number of contacts to more than four to six children increased the risk of respiratory disease among children younger than 2 years of age.<sup>5</sup>

Although we observed no differences in the risk of a number of illnesses, including lower respiratory tract illness, meningitis, and measles, we had too few cases to adequately assess possible differences in the risk of these illnesses with respect to day-care attendance. However, the increased risk of chickenpox was statistically significant for those attending day care. Furthermore, chickenpox was similar to respiratory illness in terms of the influence of older siblings and the size of the day-care facility.

A major distinction of this study is that the participants represent a cross-section of day-care attendees and nonattendees in the United States. However, a number of limitations should be considered in assessing the results. The study primarily focused on illnesses occurring in the 2 weeks before the telephone interviews, which were conducted from March 17th through June 12th, rather than during the peak period of respiratory illnesses (winter months of December through March). Caution should be used in extrapolating these results to other seasons of the year.

Additional concerns include the possibility that the parents of children attending day-care centers may be more likely to report minor symptoms as illnesses because of a preconception that such facilities are associated with an increased risk of illness. However, most of the illnesses reported by parents involved two or more respiratory symptoms that lasted 2 or more days, and many involved antibiotic therapy; furthermore, these indices of severity were reported more frequently for exposed children than for unexposed children.

That this study consisted of a nationwide representative sample of children enrolled in day care makes the assessment of attributable risk potentially meaningful from a public health perspective. Our estimates that approximately 20% to 30% of respiratory illnesses among those attending day care can be attributed to day care and that 7% to 12% of all respiratory illnesses in children younger than 5 years of age occurring in the United States during the study period may have resulted from day-care attendance are similar to those reported

for children (all <36 months) in a study conducted in metropolitan Atlanta from mid-July to mid-September.<sup>3</sup> The present study also suggests that small, compared with larger, day-care settings, specifically for children 18 through 35 months of age, are associated with a reduced risk of respiratory illness. In addition, the study also illustrates that one possible result of early day-care enrollment may be a reduced risk of respiratory illnesses among older preschool children. Further studies, including studies prospectively observing large cohorts of children in various types of day-care settings, would help determine whether a reduced rate of respiratory illness extends into the school-aged years.

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